PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Process and Arrangement for the Purification of Smoke and Waste Gases.

We, OESTERREICHISCH-ALPINE MONTANGESELLSCHAFT, of 4, Friedrichstrasse, Vienna 1, Austria, an Austrian body corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process and an arrangement for the purification of smoke and waste gases, more particularly of such waste gases which contain very fine particles of dust distributed therein.

The waste gases produced in furnaces and in various other chemical and metallurgical processes contain such fine dust frequently in such quantities, that the surrounding is thereby loaded with smoke and fields are sometimes damaged, as a result of which flows of water become polluted. Also when the waste gases are not discharged into the atmosphere but are supplied for some industrial application, the pollution may have an undesirable effect owing to the dust particles which have been dragged along. If sulphurous gases containing particles of calcined ore that has been dragged along are used in the cellulose industry these impurities have a detrimental effect. Moreover, the dust particles carried along by the waste gases may also reduce the yield of the process in which they were produced. This applies also to metallurgical processes.

It has been suggested already to purify gases by injecting a liquid spray into them, but such processes have not been successful.

The object of the invention is to provide a purification process which will enable the purification of smoke in general, and more particularly the purification of waste gases containing dust in a very finely divided condition, to be effected with good efficiency, and the invention essentially consists in passing the gases to be purified through a column of a liquid the surface tension of which is smaller than that of water, more particularly with water containing an addition of wetting means. Tests have shown, that no useful results can be obtained with ordinary water which, as is known, has a surface tension lying in the range of 70-74 dyn/cm according to the temperature. The wetting ability of ordinary water is not sufficient to enable these very fine dust particles to be seized. However, if liquids are used the surface tension of which is smaller than that of water, or if the surface tension of the water is reduced by the addition of wetting means, good results are obtained. The reduced surface tension enables even the smallest particles of dust to be seized, which now can be separated from the smoke and the waste gases. It has been found an advantage to use liquids which have a surface tension less than 60 dyn/cm, preferably even below 50-40 dyn/cm, or to reduce the surface tension of the water to these values by the addition of wetting means. Whilst, when use is made of ordinary water, the gases rise in the water in the form of comparatively large bubbles, without the dust floating therein in very fine distribution being seized by the liquid, the surface tension of the liquid reduced according to the invention enables the gases to be so wetted that the dust particles are seized by the liquid and are at least retained therein in substantial quantity.

Different measures may be used separately or jointly in order to obtain an extensive or complete wetting of the gases, or dust particles, by the liquid. The pressure of the gases at their point of admission into the liquid is so chosen, that it is not substantially higher than the hydrostatic pressure at this point. In this way it is avoided that the gases which are pressed into the liquid will rise too quickly, and in an agglomerated condition, in the liquid and, in spite thereof, drag dust particles along with them. It is also advisable to introduce the gases into the liquid in a finely distributed state, for instance through a large number of outlet openings or nozzles, preferably divided over a large surface of a liquid container, so that the gases which ascend in the liquid are distributed as much as possible throughout

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the liquid. This gas distribution in the liquid may be improved mechanically, for instance by eddying and/or by the arrangement of sieves, nets or guiding plates. Since the gases ascend in the liquid it is an advantage to introduce them as far as possible below the level of the liquid, according to the available depth of the liquid container.

Tests have shown that in this manner a good or even perfect purification can be achieved. The reduced surface tension of the cleansing liquid, or the addition of wetting agents, however, promotes the formation of foam at the surface of the cleansing liquid, whereby the performance of the purification process is rendered more difficult. Where the gases to be purified are passed through at high rates, the formation of foam may assume such an extent as to impair considerably the performance of the purification process because progressively increasing amounts of the cleansing liquid pass into foam, which is less effective in cleansing, and owing to the large volume of the foam the foam level rises above the height of the liquid container provided.

According to the invention that formation of foam can be opposed by increasing the surface tension in the surface zone of the cleansing liquid. Thereby the increased surface tension in the surface zone of the cleansing liquid prevents the formation of foam, whereas the surface tension of the cleansing liquid itself remains reduced to provide for an effective purification by wetting the gases.

The surface tension in the surface zone of the cleansing liquid may be increased according to the invention simply by placing on the cleansing liquid having a low surface tension a liquid, such as more particularly oil which does not mix with the cleansing liquid and has a higher surface tension and lower specific gravity. Owing to its lower specific gravity and its property not to mix with the cleansing liquid or water, the oil or the like will permanently remain on the surface of the cleansing liquid to form there a thin layer, which does not reduce in any way the cleansing effect of the underlying liquid but at the liquid surface where the gases emerge in a purified condition increases the surface tension sufficiently to avoid a formation of foam completely or at least to a great extent. It has been found that a thin layer of oil or the like is sufficient to achieve this effect and that it is sufficient to place the oil on the cleansing liquid in amounts so small as to form only a thin oil film covering the surface of the cleansing liquid. A sufficient effect in preventing or reducing the formation of foam was obtained already by the application of some cubic centimetres of oil per square metre of the surface of the cleansing liquid.

In the simplest case the cleansing liquid consists of water, which has added thereto one of the usual commercially available surface tension reducing agents to the extent of 1 to 1/10 parts per 1000. This reduces the surface tension of the water to about 30-40 dyn/cm, which is sufficient for a perfect or almost perfect cleansing effect in the case of waste gases from metallurgical processes, e.g. waste gases from a converter, which contain dust particles of the order of 1 micron. By pouring on the surface per square metre some cubic centimetres of ordinary Diesel oil which has proved particularly suitable for providing the surface layer of increased surface tension, a formation of foam can be avoided in this case completely or almost completely.

The treatment of the liquid which becomes saturated with impurities in the course of time depends on the kind of gases which are to be purified and the proportion of impurities contained therein. When the impurities or dust particles are contained in the gases to be purified only in a small quantity, the simplest way is to renew the saturated liquid. However, if the impurities or dust particles of the gases to be purified, and the amount of these gases themselves, are in a too large quantity, and/or if these impurities or dust particles are valuable, recovery of the impurities and of the dust particles from the liquid and conservation of this liquid is justified. Of course, in some cases it may also be possible to supply the liquid, saturated with the impurities or dust particles, for use in some process, if the chemical composition of the saturated liquid is suitable. According to the kind of the dust particles or impurities their separation out of the liquid may be effected continuously, or after their saturation, for instance magnetically, electrically or by evaporation of the whole of the liquid. A precipitation of the impurities or dust particles from the liquid may be advantageously effected by chemical additions. The waste gases obtained in a metallurgical process frequently contain substantial proportions of iron oxide, amounting to more than 1% of the charge. Therefore, a recovery of the same seems to be of interest, and the recovery may cover the cost of the purifying and recovery process. This recovery may be effected by means of a magnetic separator, known *per se*, or, as already stated, electrolytically, also by well known measures, and the dust particles or impurities recovered from the liquid may be supplied to a pyrometallurgical process, for instance to a blast furnace, a convertor or a sintering installation. If desired, also the scum formed on the liquid and containing such dust particles or impurities may be drawn off and be supplied as such to the pyrometallurgical process.

In one mode of carrying the process according to the invention into effect, the gases to be purified and the liquid may, if desired, be led in a counter-current to each other, the liquid being conducted in a pipe or channel in a compact stream against the gas stream. Such a pipe or channel may also be arranged inclined or vertically, so that the liquid flows downwards and

the gases upwards.

The process according to the invention has the greatest advantages in pyrometallurgical processes in which the smoke trouble is an important factor, but it may also be used for the purification of gases of any kind, if desired, also for the purification of air containing dust, and any kind of smoke can be purified by the process according to the invention.

An arrangement for carrying out the process according to the invention is essentially characterised by the provision of a liquid container, in the lower region of which opens a smoke or waste gas pipe, and preferably by a blower inserted in the smoke or waste gas pipe.

In the arrangement according to the invention outlet openings for the gases to be purified are distributed over the whole bottom of the container, so that the gases flow through the liquid very finely distributed. The distribution of the gases in the liquid may also be effected by the arrangement of sieves, nets or guiding plates, such sieves or nets being preferably arranged approximately horizontally. Also when the sieves or nets are of comparatively fine or narrow mesh, the reduced surface tension of the liquid permits the gases to pass freely through. When use is made of guiding plates, they may be so arranged that the passage of the gases through the liquid is greatly lengthened.

The accompanying drawing illustrates an embodiment of the invention which shows the removal of dust from converter waste gases.

Fig. 1 shows an elevation of the installation, partly in section; Fig. 2 shows a section on line II-II of Fig. 1; Fig. 3 shows a detail, viz. a distribution tube on a large scale.

1 is a converter in which pig iron is blown to steel. Through tube 2 oxygen or another oxidizing gas is blown against the surface of the iron bath in the converter whereby the oxidizing process is carried out. From the converter mouth 3 the waste gases are expelled which are polluted by finely distributed dust. 4 designates a cap to which a flue 5 is connected. In the flue 5 a damper 6 is built in, which is rotatable about an axle 7. If this damper is opened, the waste gases flow through the upper part 5' of the flue into the atmosphere.

To the flue 5 below damper 6 a conduit 8 is connected. If the damper 6 is closed, the waste gas flows into conduit 8 and in order to avoid excessive pressure in flue 5 is sucked off by a blower 9. To the outlet opening of blower 9 is connected a tube 11. To this tube 11 are in turn joined a plurality of pipes 12. The pipes 12 extend into a vessel 13 and the lower parts 12' of pipes 12 are arranged adjacent to the bottom 14 of vessel 13. In horizontal pipe parts 12' small holes 15 are provided. Vessel 13 is filled with a liquid which has a lower surface tension than water, viz. with a water to which were added wetting means for decreasing the surface tension. Vessel 13 is closed on top by plate 16 to which a cupola 17 is tightly secured. At the upper end of cupola 17 an exhaust tube 18 is joined.

In flue 5 a pipe coil 19 may be provided to which a cooling liquid, e.g., water, is supplied at 20. At 21 the heated water drains so that on one hand the gases streaming through flue 5 are cooled and on the other hand heat is recovered.

The gases developing in converter 1 and tainted with dust flow with damper 6 closed through conduit 8 to blower 9 and are pressed by same into horizontal pipe parts 12'. Through holes 15 these gases flow out finely distributed and are cleaned by the liquid in vessel 13, the dust being retained in the liquid. The cleaned gases escape through cupola 17 and exhaust tube 18 into the atmosphere. Since the gases flowing through the water in vessel 13 may develop foam, cupola 17 has a comparatively large volume so that the possibly developed foam may be received into cupola 17. In order to lessen this foam formation or to prevent it entirely, a liquid may be applied to the surface of the liquid in vessel 13 which has a higher surface tension than the surface-tension-relieved water and the specific gravity of which is less than that of water so that a surface layer of higher surface tension develops. For this purpose Diesel fuel proved suitable.

What we claim is:—

1. A process for the purification of smoke and waste gases produced by pyrometallurgical processes and containing very fine oxide particles of an average size of 1 micron distributed therein, characterised in that the gases are led through a body of water, the surface tension of which has been reduced below 50 dyn/cm by means of a water-soluble wetting agent.

2. A process as claimed in claim 1, characterised in that the pressure of the gases at the point of admission into the liquid does not substantially exceed the hydrostatic pressure at this point.

3. A process as claimed in claim 1 or 2, characterised in that the gases to be purified and the liquids are led through a pipe or channel in a counter-current to each other.

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756,405 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig. 3

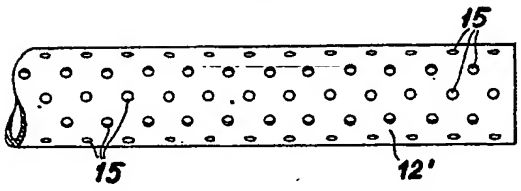

Fig. 1

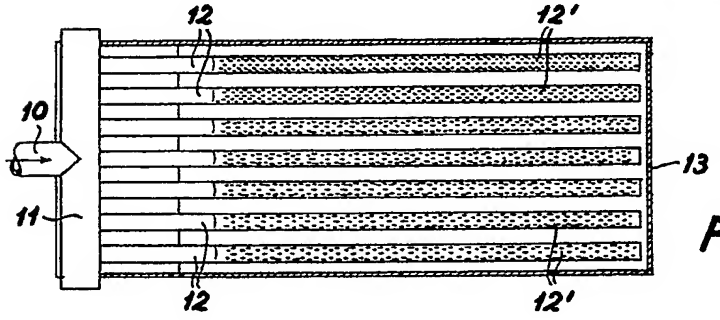

Fig. 2